SUB-DOPPLER JET-COOLED INFRARED SPECTROSCOPY OF $ND_2H_2^+$ AND ND_3H^+ IN THE NH STRETCH FUNDAMENTAL MODES

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Sub-Doppler jet-cooled rovibrational spectra of ND_3H^+, $ND_2H_2^+$, and NDH_3^+ ions in various fundamental NH modes were observed and analyzed using difference frequency generation infrared spectroscopy. The ions were generated in the concentration-modulation slit-jet expansion via a H_3^+ proton transfer mechanism in a discharge mixture of ND_3/H_2O and H_2 gases. NH mode excitation in ND_3H^+ ion yielded a prominent *Q* branch feature and parallel band rotational structure. Rotational transitions were confirmed unambiguously by four-line ground state combination differences within frequency measurement accuracy (10 MHz). The band origin was determined to be 3316.8413(9) cm^{-1}. Perturbation in the upper state was observed from analysis of residuals. In the case of $ND_2H_2^+$, both NH symmetric (*b*-type) and anti-symmetric (*c*-type) modes were observed and assigned for the first time, yielding band origins of 3297.5440(1) and 3337.9050(1) cm^{-1}, respectively. The intensity for the two fundamental bands was interpreted with simple context of a bond-dipole model. The present study provided high precision ground state rotational constants (A''=4.85675(4), B''=3.96829(4), C''=3.44667(6) cm^{-1}), which should facilitate microwave searches for isotope-substituted ammonium ions in the regions of interstellar medium, such as dense molecular clouds or younger stellar objects.